Plasma Membrane

Chapter 5.1

Biol 1A

California State University, Fresno

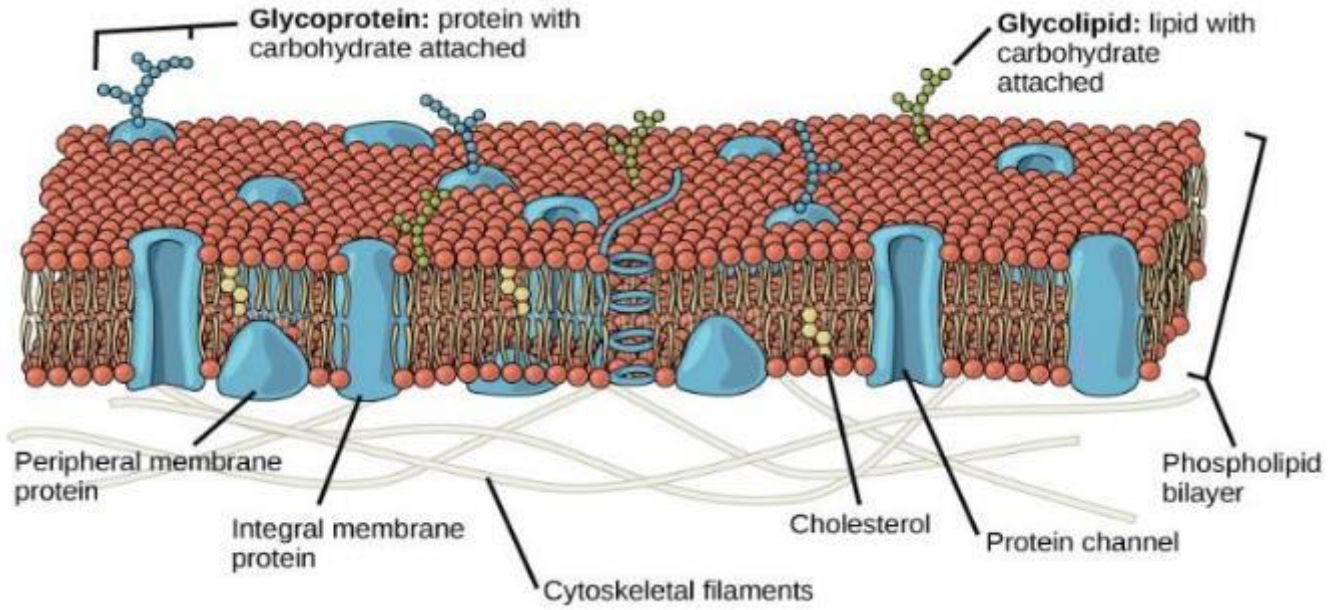
Learning Goals

- Describe the components of the plasma membrane
- Identify factors that affect the fluidity of the cell membrane

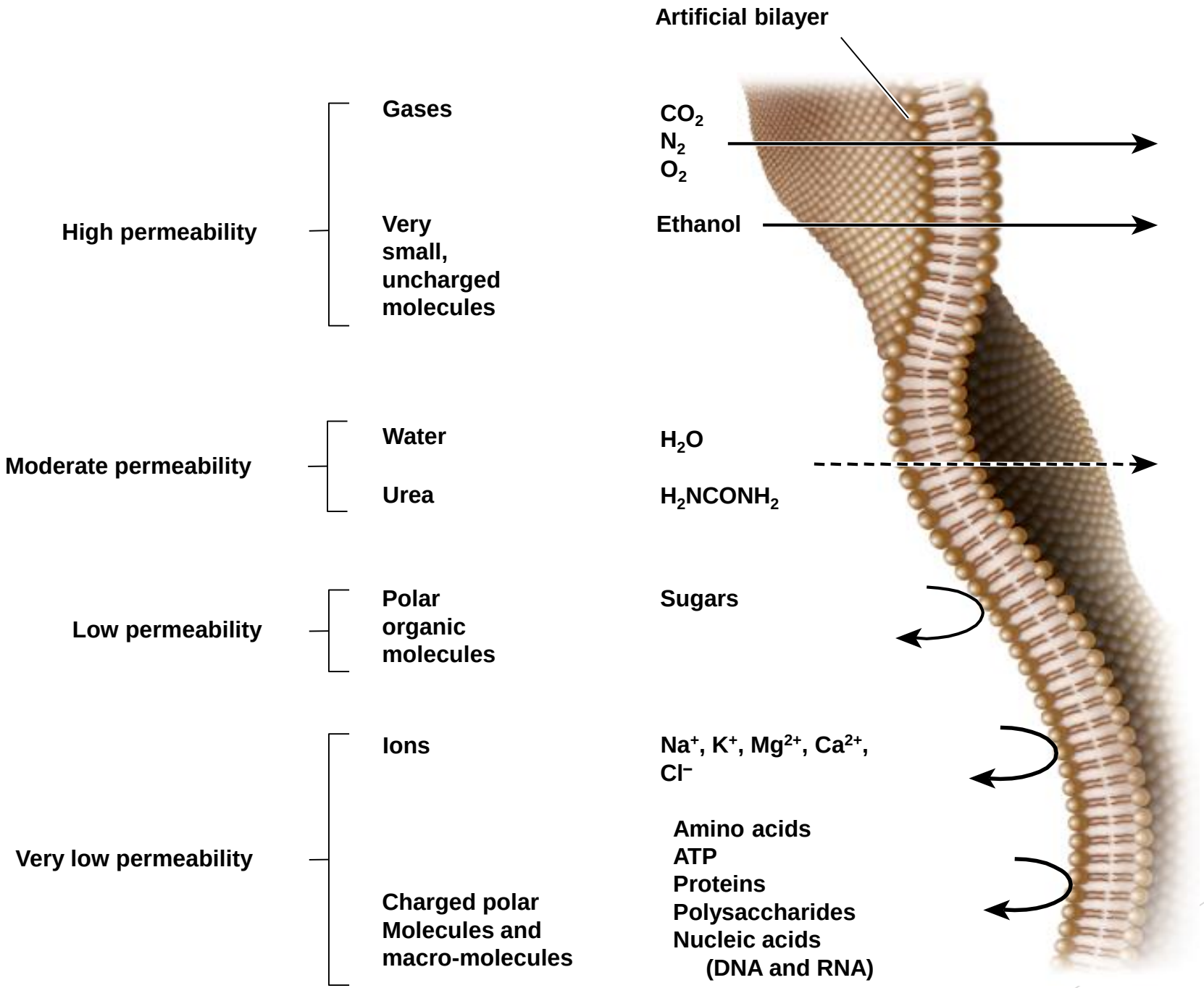
The Plasma Membrane

- The plasma membrane has many functions, but the most basic one is to define the borders of the cell and keep the cell functional.

- The plasma membrane is **selectively permeable.**



The Plasma Membrane is semi-permeable



Fluid Mosaic Model

- The explanation proposed by Singer and Nicolson is called the **fluid mosaic model**.
- The fluid mosaic model describes the structure of the plasma membrane as a mosaic of components—including **phospholipids**, **cholesterol**, **proteins**, and **carbohydrates**—that gives the membrane a fluid character.

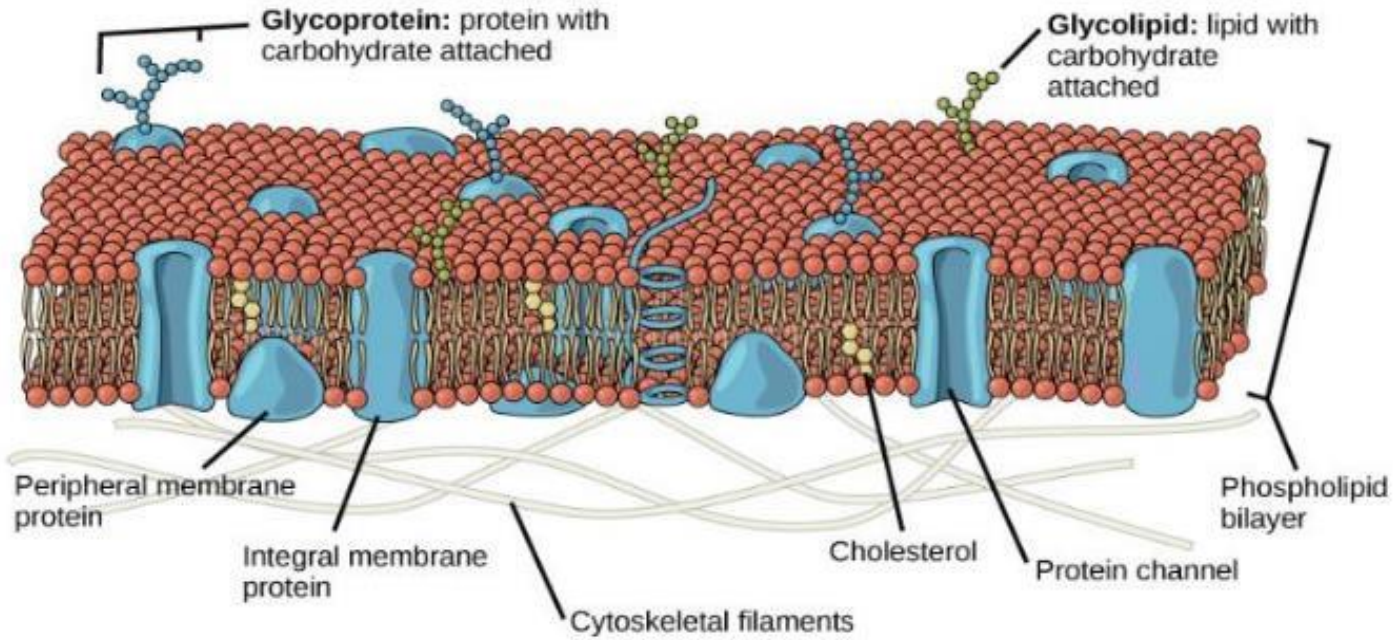
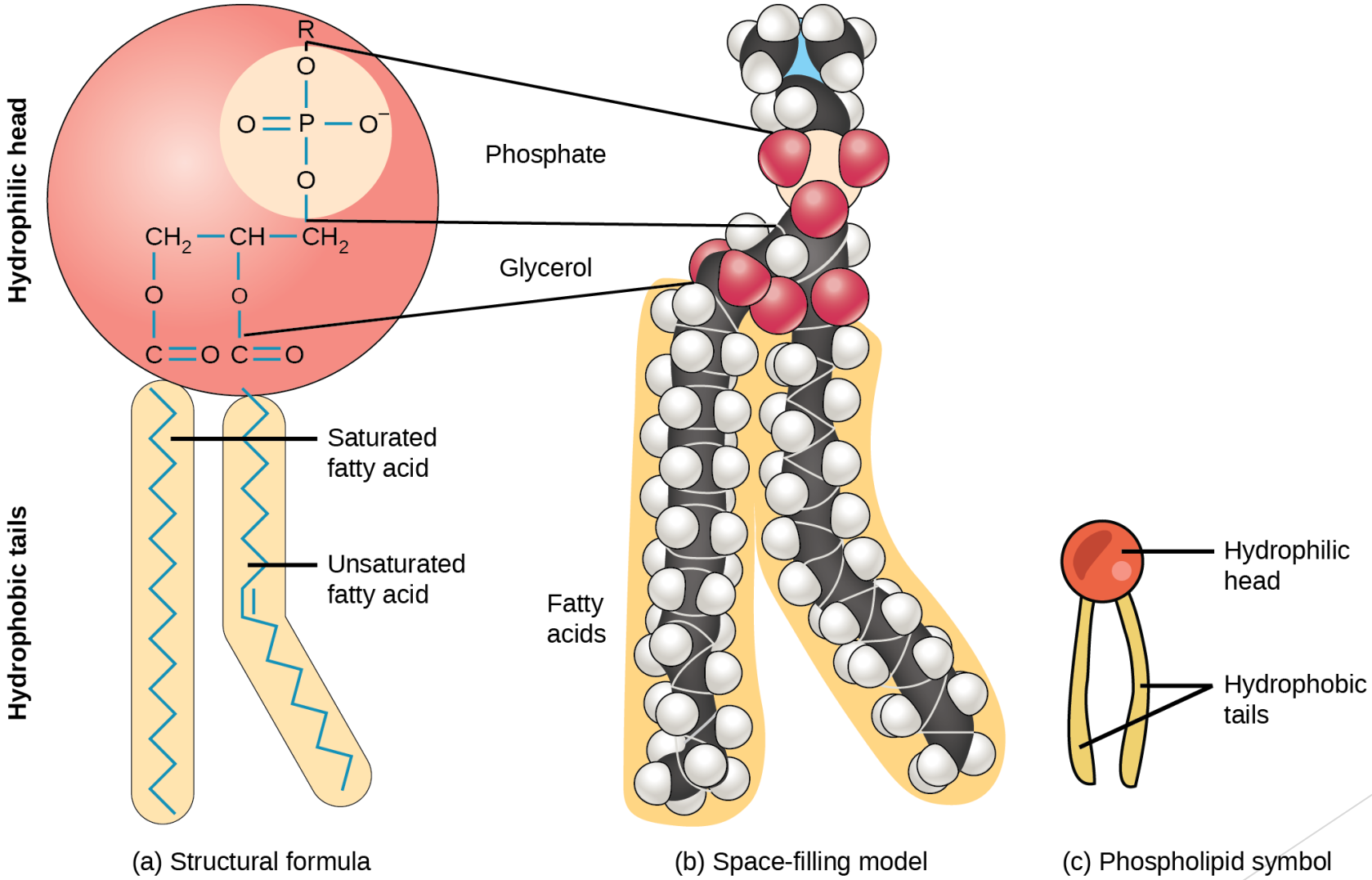


FIGURE 5.2 The fluid mosaic model of the plasma membrane describes the plasma membrane as a fluid combination of phospholipids, cholesterol, and proteins. Carbohydrates attached to lipids (glycolipids) and to proteins (glycoproteins) extend from the outward-facing surface of the membrane.

Phospholipids

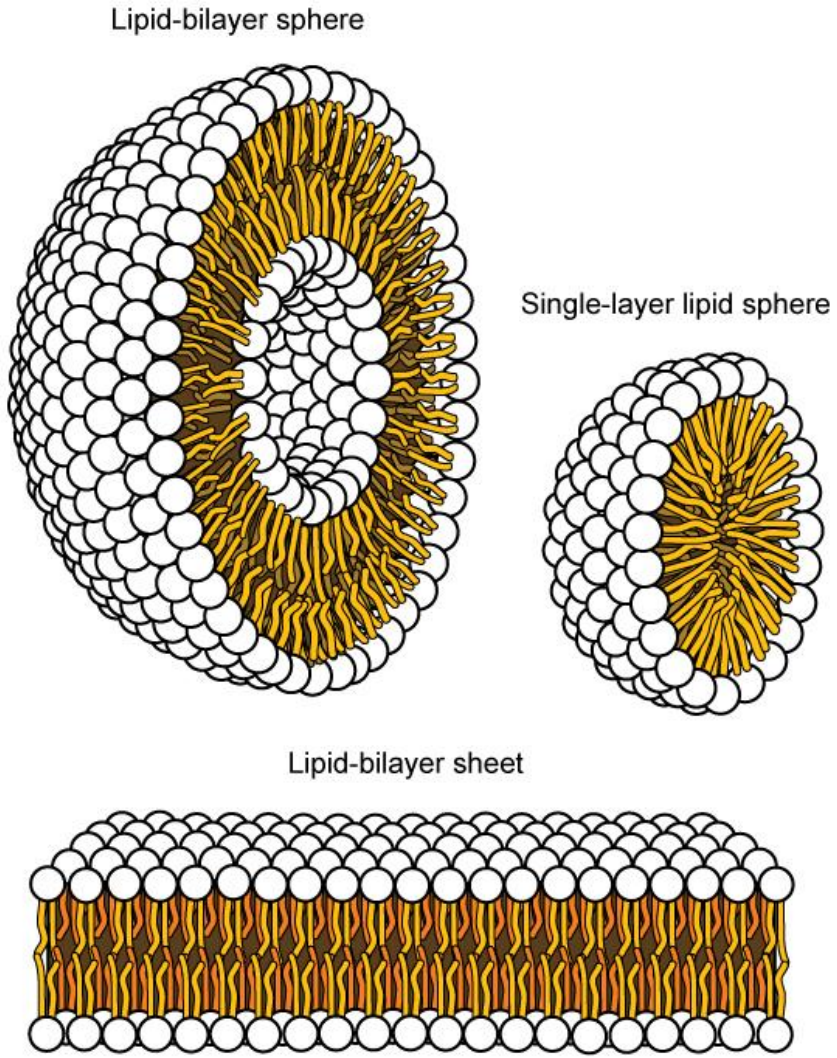


(a) Structural formula

(b) Space-filling model

(c) Phospholipid symbol

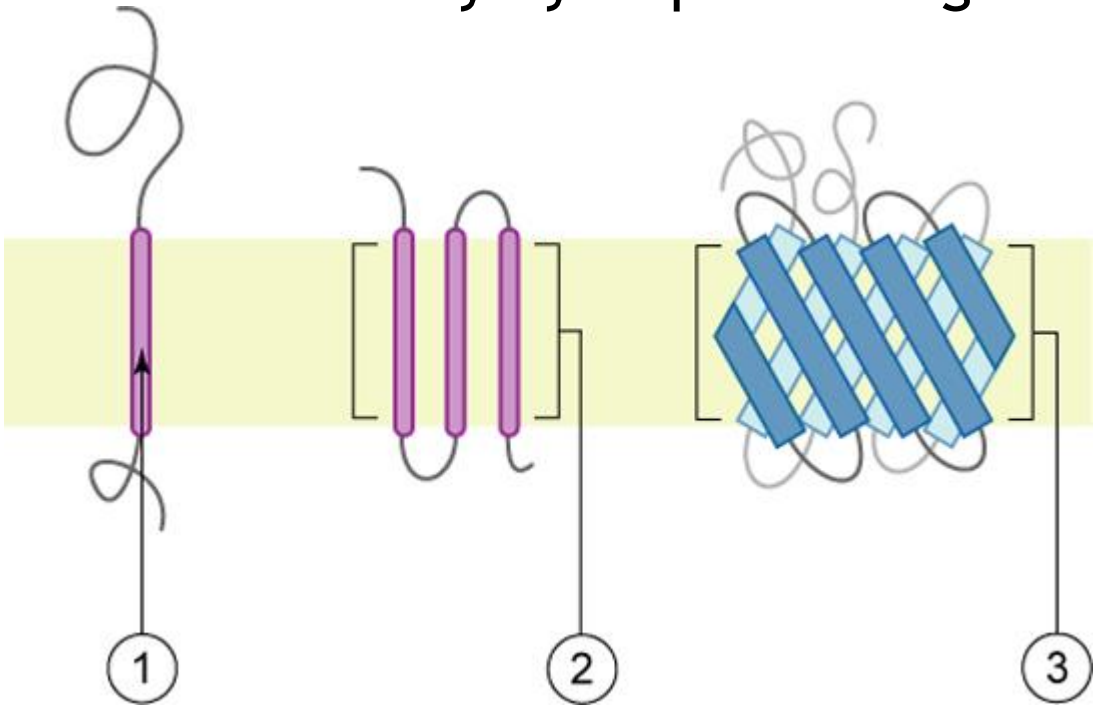
Lipid Bilayer



Proteins

- **Integral proteins** are integrated completely into the membrane structure, and their hydrophobic membrane-spanning regions interact with the hydrophobic region of the phospholipid bilayer.

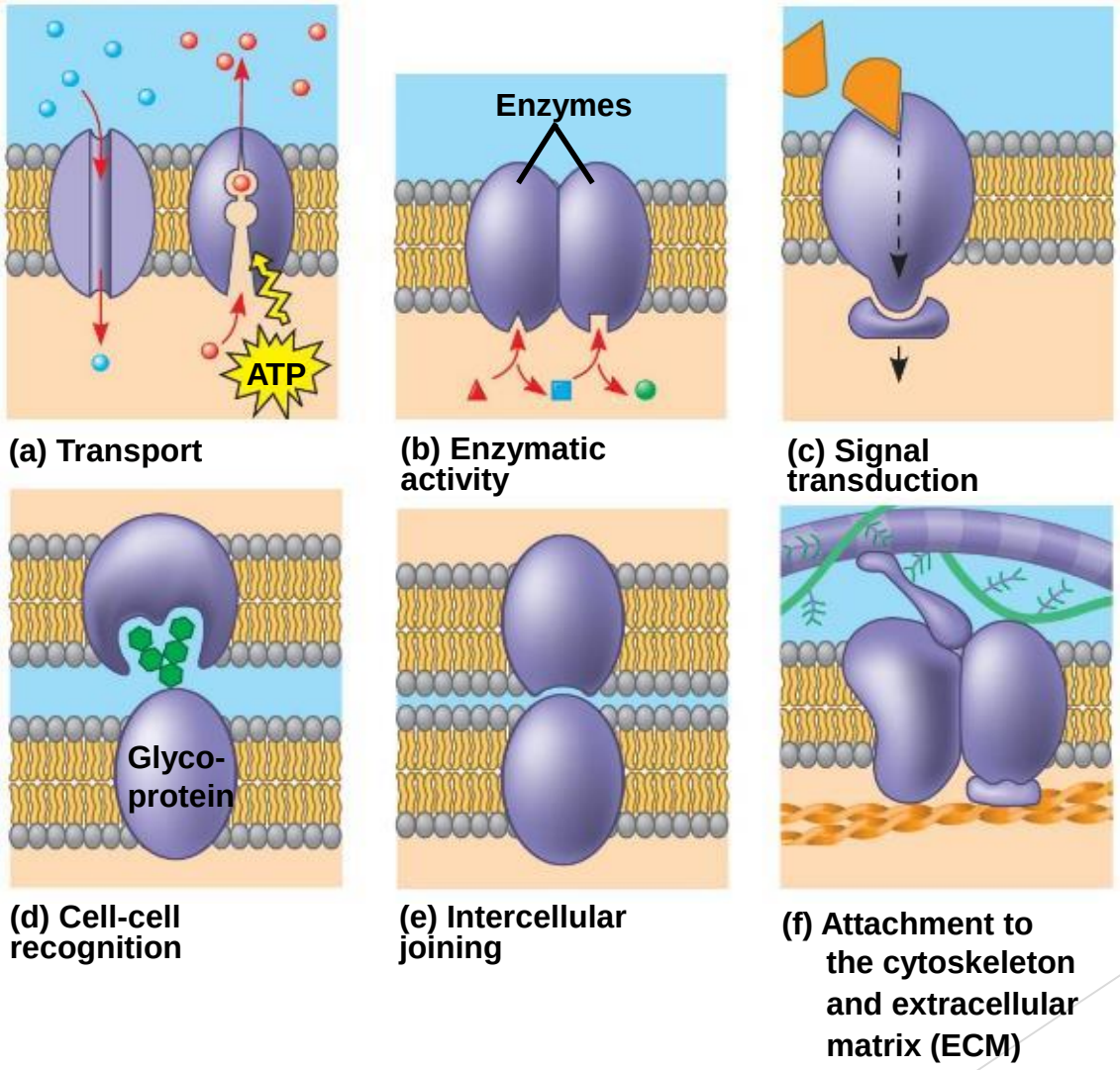
- This type of protein has a hydrophilic region or regions, and one or several mildly hydrophobic regions.



Membrane Proteins

Six major functions of membrane proteins:

1. Transport
2. Enzymatic activity
3. Signal transduction
4. Cell-cell recognition
5. Intercellular joining
6. Attachment to the cytoskeleton and extracellular matrix (ECM)



(a) Transport

(b) Enzymatic activity

(c) Signal transduction

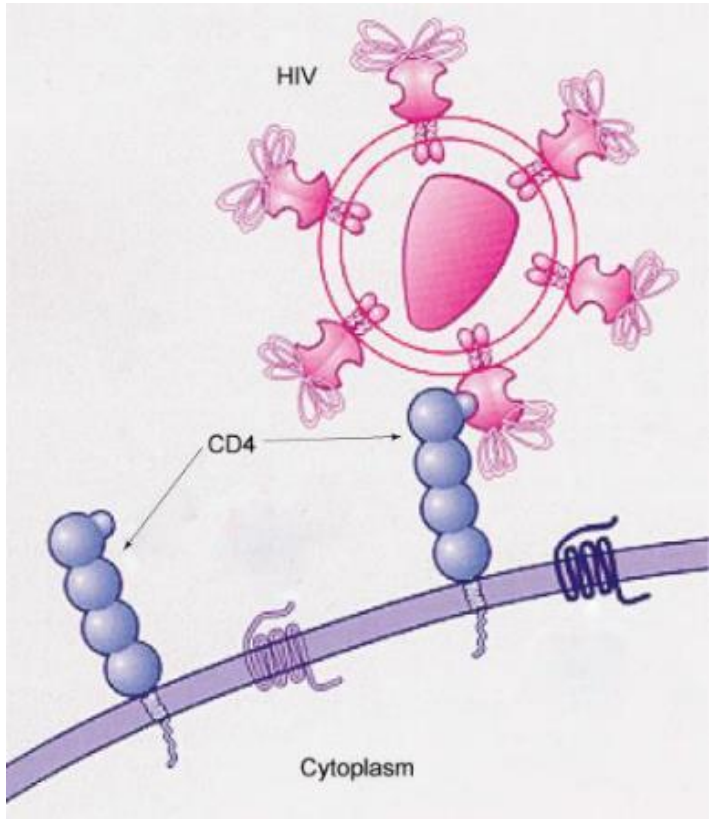
(d) Cell-cell recognition

(e) Intercellular joining

(f) Attachment to the cytoskeleton and extracellular matrix (ECM)

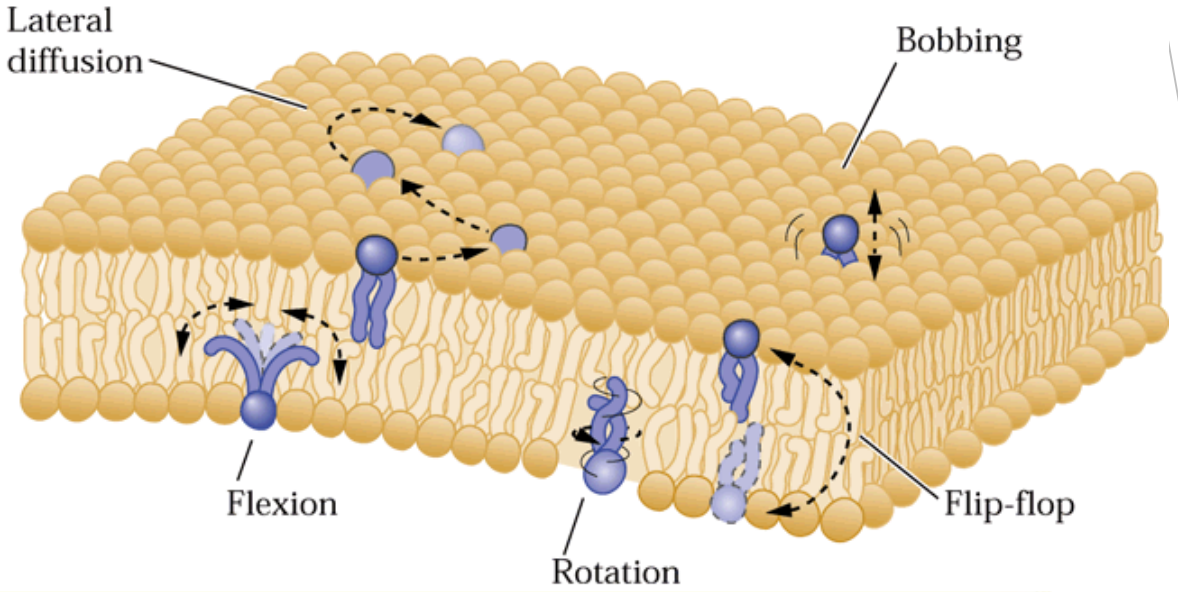
Carbohydrates

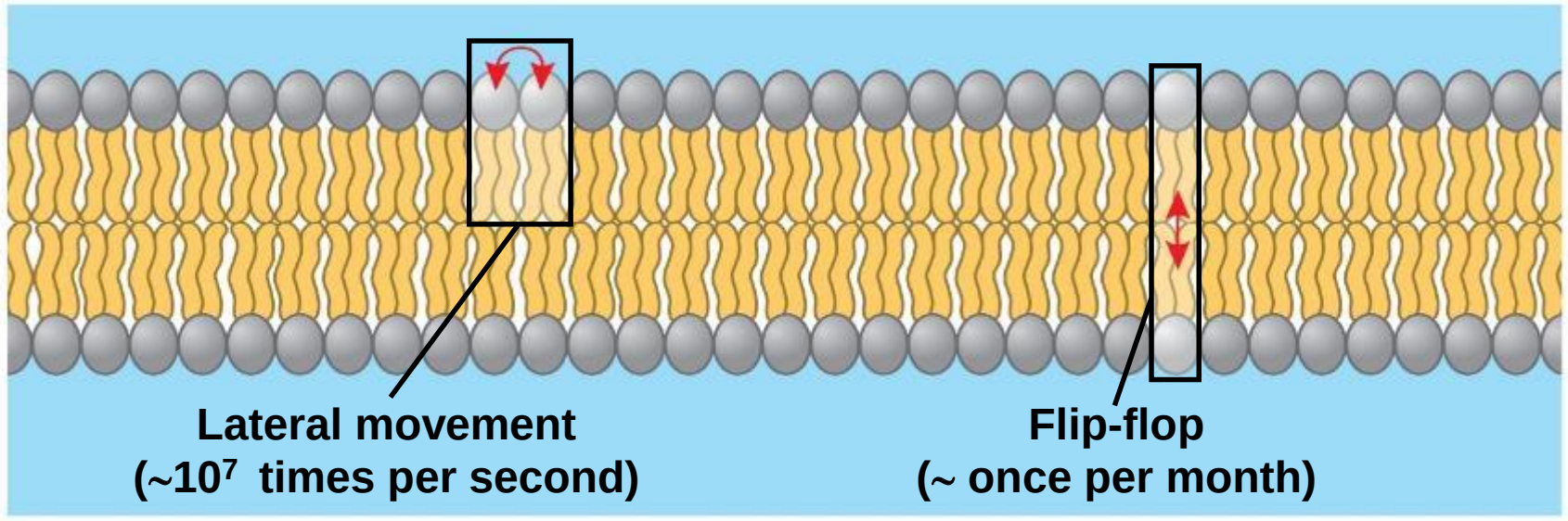
- Carbohydrates are the third major component of plasma membranes.
- They are always found on the exterior surface of cells and are bound either to proteins (forming **glycoproteins**) or to lipids (forming **glycolipids**).
- Collectively called the **glycocalyx**



Membrane Fluidity

Phospholipids in the plasma membrane can move within the bilayer





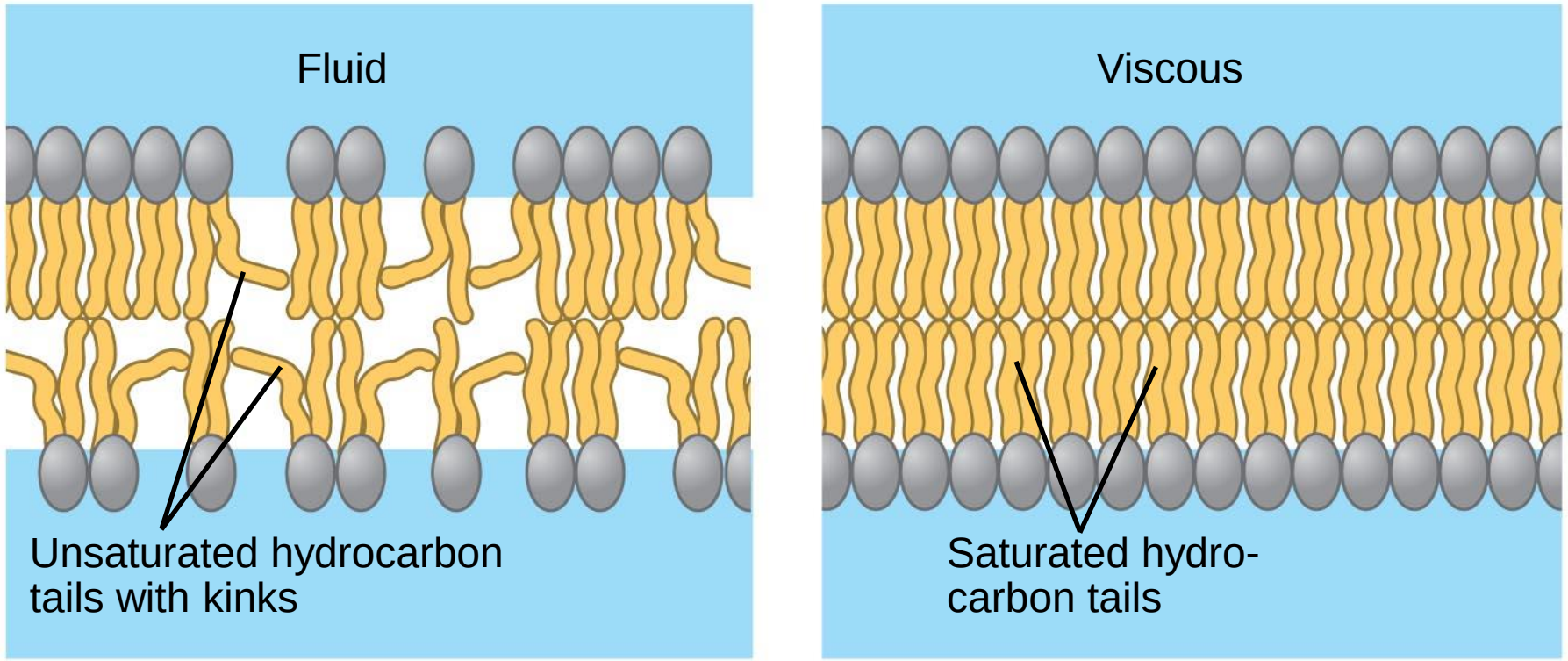
Determinants of membrane fluidity

- temperature
- saturation of fatty acid tails
- cholesterol

Temperature

Increased temperature = increased fluidity

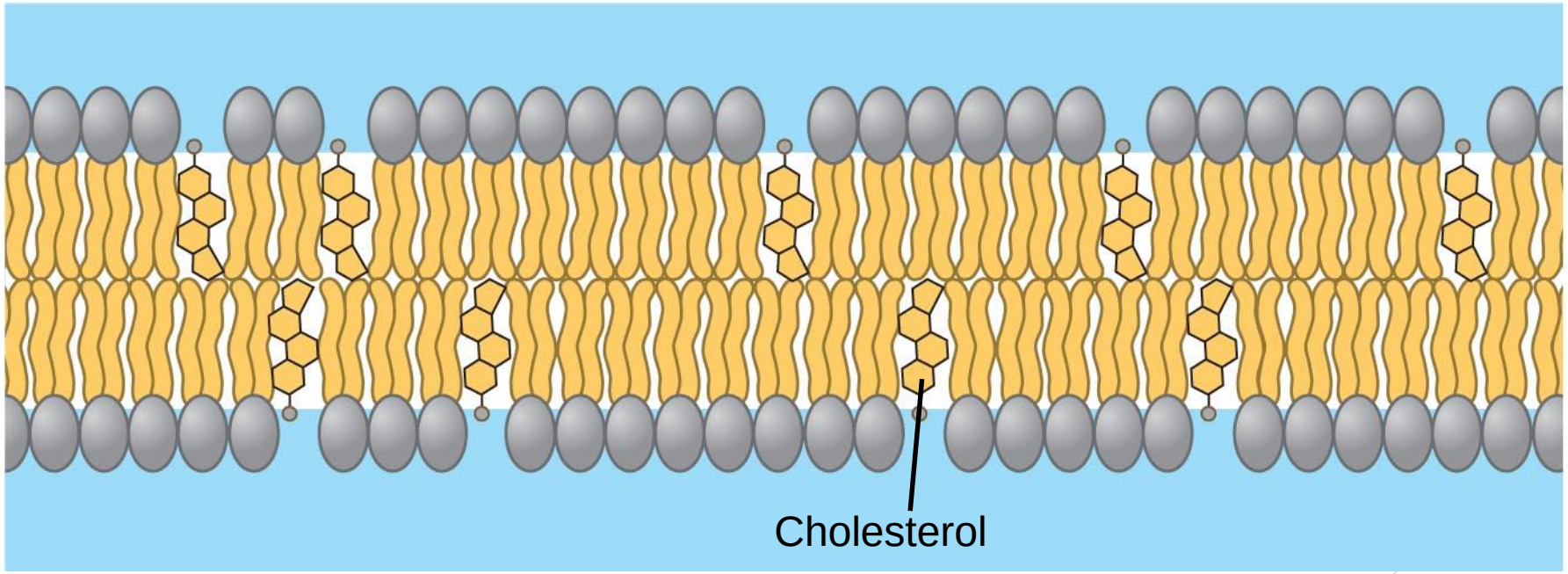
cis double bonds in fatty acid tails make membranes more fluid



Cholesterol has dual effects on fluidity

- at high temperature, cholesterol restricts movement of phospholipids

- at lower temperature, it prevents packing of phospholipids



Consider a fish that lives in extremely cold waters near Antarctica.

Develop a hypothesis to explain how the plasma membranes of the cell resist freezing.

Take Home

- The plasma membrane is dynamic and made of a phospholipid bilayer, membrane proteins, carbohydrates and cholesterol.
- The temperature, saturation of phospholipid fatty acids and cholesterol affect the fluidity of the membrane.
- Fluidity increases as temperature increases.
- Fluidity increases with an increase in unsaturated fatty acids.
- Cholesterol acts as a buffer, increasing fluidity at low temperature and decreasing fluidity at high temperatures